

AMENDMENTS TO THE SPECIFICATION

Please DELETE the section heading at page 9, line 5.

Please replace the section heading at page 12, line 15 with the following rewritten section heading:

-- ~~MEANS FOR SOLVING THE PROBLEM~~SUMMARY OF THE INVENTION--

Please DELETE the section heading at page 17, line 12.

Please replace the paragraphs beginning at page 20, line 5 and ending on page 24, line 17 with the following rewritten paragraphs:

[Fig. 1] Fig. 1 is a graph showing a reaction ratio and a DTA pattern when an aluminum nitride substrate is heated in an oxygen atmosphere.;

[Fig. 2] Fig. 2 is a diagram illustrating specific cracks.;

[Fig. 3] Fig. 3 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 1.;

[Fig. 4] Fig. 4 is a sketch of the SEM photograph shown in Fig. 3.;

[Fig. 5] Fig. 5 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 1.;

[Fig. 6] Fig. 6 is a sketch of the TEM photograph shown in Fig. 5.;

[Fig. 7] Fig. 7 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 2.;

[Fig. 8] Fig. 8 is a sketch of the SEM photograph show in Fig. 7.;

[Fig. 9] Fig. 9 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 2.;

[Fig. 10] Fig. 10 is a sketch of the TEM photograph shown in Fig. 9.;

[Fig. 11] Fig. 11 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 1.;

[Fig. 12] Fig. 12 is a sketch of the SEM photograph shown in Fig. 11.;

[Fig. 13]—Fig. 13 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 2.;

[Fig. 14]—Fig. 14 is a sketch of the SEM photograph shown in Fig. 13.;

[Fig. 15]—Fig. 15 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 1.;

[Fig. 16]—Fig. 16 is a sketch of the TEM photograph shown in Fig. 15.;

[Fig. 17]—Fig. 17 is a TEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 2.;

[Fig. 18]—Fig. 18 is a sketch of the TEM photograph shown in Fig. 17.;

[Fig. 19]—Fig. 19 is a cooling system diagram of a typical cooling device according to the present invention.;

[Fig. 20]—Fig. 20 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 8.;

[Fig. 21]—Fig. 21 is a sketch of the SEM photograph shown in Fig. 20.;

[Fig. 22]—Fig. 22 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 8.;

[Fig. 23]—Fig. 23 is a sketch of the TEM photograph shown in Fig. 22.;

[Fig. 24]—Fig. 24 is an SEM photograph showing a surface state of a surface oxidized aluminum nitride susceptor produced in Example 8 before a plasma treatment in carrying out a corrosion resistance test II.;

[Fig. 25]—Fig. 25 is an SEM photograph showing a surface state of the surface oxidized aluminum nitride susceptor shown in Fig. 24 after the plasma treatment.;

[Fig. 26]—Fig. 26 is an SEM photograph showing a surface state of an aluminum nitride susceptor not having an oxide layer on its surface before a plasma treatment in carrying out a corrosion resistance test II.;

[Fig. 27]—Fig. 27 is an SEM photograph showing a surface state of the surface oxidized aluminum nitride susceptor shown in Fig. 24 after the plasma treatment.;

[Fig. 28] Fig. 28 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 9-;

[Fig. 29] Fig. 29 is a sketch of the SEM photograph shown in Fig. 28-;

[Fig. 30] Fig. 30 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Example 9-;

[Fig. 31] Fig. 31 is a sketch of the TEM photograph shown in Fig. 30-;

[Fig. 32] Fig. 32 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 8-7;

[Fig. 33] Fig. 33 is a sketch of the SEM photograph shown in Fig. 32-;

[Fig. 34] Fig. 34 is an SEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 9-8;

[Fig. 35] Fig. 35 is a sketch of the SEM photograph shown in Fig. 34-;

[Fig. 36] Fig. 36 is a TEM photograph of the cross-section of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 8-;

[Fig. 37] Fig. 37 is a sketch of the TEM photograph shown in Fig. 36-;

[Fig. 38] Fig. 38 is a TEM photograph of the surface of an oxide layer in an aluminum nitride substrate having an oxide layer on its surface produced in Comparative Example 9-; and

[Fig. 39] Fig. 39 is a sketch of the TEM photograph shown in Fig. 38.

Please DELETE the section heading and entire section that begins on page 24, line 18 and ends on page 25, line 9.

Please replace the section heading at page 25, line 11 with the following rewritten section heading:

-- ~~BEST MODE FOR CARRYING OUT~~DETAILED DESCRIPTION OF
~~THE INVENTION~~ --

Please replace the paragraphs beginning at page 74, line 19 and that end on page 76, line 24 with the following rewritten paragraphs:

-- Comparative Examples 5 and 6 Example 5 (Examples of novel oxidation process in which the partial pressure of oxygen in the initial period of contact is outside the scope of the present invention)

An aluminum nitride substrate in a plate form having a size of 50.8 mm in length, 50.8 mm in width, and 0.635 mm in thickness and a surface roughness Ra of not more than 0.05 µm (SH 15, manufactured by TOKUYAMA Corp.) was heated to 1200°C using the same apparatus as in Example 1 under the same conditions as in Example 1. After it was confirmed that the temperature around the substrate reached 1200°C, the flow of nitrogen gas was stopped. The inside of the furnace was evacuated by a rotary vacuum pump to not more than 50 Pa. Thereafter, the pressure in the inside of the furnace was rapidly increased by oxygen gas (purity 99.999%, dew point -80°C) to the atmospheric pressure while replacing the atmosphere within the furnace by the oxygen gas, and the oxygen gas was flow into the furnace at a flow rate of 2 (l/min.), and this condition was held for 5 hr to oxidize the surface of the aluminum nitride substrate. After the completion of oxidation, the substrate was cooled to room temperature (cooling down rate: 3.3°C/min.) to provide a surface oxidized aluminum nitride substrate (Comparative Example 5). Alternatively, a surface oxidized aluminum nitride substrate was produced in quite the same manner as in Comparative Example 5, except that the increase in pressure was carried out using an oxidizing gas prepared by mixing nitrogen gas (purity 99.99995%, dew point 80°C) and oxygen gas (purity 99.999%, dew point 80°C) together to give a partial pressure of oxygen gas of 50 kPa (Comparitive Example 6).

The surface oxidized aluminum nitride substrate (sample) was analyzed by X-ray diffractometry (XRD), a scanning electron microscope (SEM) and a transmission electron microscope (TEM) in the same manner as in Example 1. As a result, it was found from a diffraction pattern provided by XRD measurement that, for all the samples, the oxide layer was formed of α -alumina. The thickness of the oxide layer was 3100 nm on average for the sample of Comparative Example 5 and was 2800 nm on average for the sample of Comparative Example 6. The surface observation by SEM revealed that, for both the samples, not only a ridge-like streak pattern but also nonspecific cracks were observed on the surface of the oxide layer. Further, the observation of the cross-section of the sample by TEM revealed that elliptical cells (or voids) were present in all the oxide layers. Further,

unlike Examples 1, 2, and 3, in all the samples, cells were also observed in a part around the interface of the oxide layer and the underlying material. For the prepared sample, an alkali immersion test and a tape peel test were carried out in the same manner as in Example 1. As a result, a weight reduction of the sample in an alkali immersion test was 50 (g/m²) for Comparative Example 5 and was 40 (g/m²) for Comparative Example 6, and, in the tape peel test, there was dropout of the sample structure. --

Please replace the paragraph at page 90, line 2 with the following rewritten paragraph:

-- Comparative Example 76 (Example of new oxidation process without degassing treatment) --

Please replace the paragraphs beginning at page 92, line 19 that end at page 95, line 20 with the following replacement paragraphs:

-- Comparative Examples 87 and 98

The same aluminum nitride susceptor as used in Example 8 was introduced into a high-temperature atmosphere furnace comprising a mulite ceramic having an inner diameter of 200 mm and a length of 1100 mm as a furnace tube. The furnace was heated to 1200°C (heating up rate: 3.3°C/min.) under the flow of dry air into the furnace at a flow rate of 2 (l/min.). After the temperature around the susceptor was confirmed to reach 1200°C, this state was held for one hr to oxidize the surface of the susceptor. After the completion of oxidation, the substrate was cooled to room temperature (cooling down rate: 3.3°C/min.) to provide a surface oxidized aluminum nitride susceptor (Comparative Example 87). Further, a surface oxidized aluminum nitride susceptor was produced by oxidation in quite the same manner as in Comparative Example 87, except that the holding time was changed to 10 hr (Comparative Example 98).

The wafer mounting surface of the surface oxidized aluminum nitride susceptor (sample) was analyzed by X-ray diffractometry (XRD), a scanning electron microscope (SEM) and a transmission electron microscope (TEM) in the same manner as in Example 8. As a result, it was found from the diffraction pattern obtained in XRD measurement that, for all the samples, the oxide layer was formed of α -alumina. The thickness of the oxide layer was 1400 nm on average for the sample of Comparative Example 87 and was 16000 nm on average for the sample of Comparative Example 98.

The results of the observation of the surface of the sample of Comparative Example 8 by SEM are shown in Fig. 32 (photograph) and Fig. 33 (illustration of Fig. 32), and the results of the observation of the surface of the sample of Comparative Example 98 by SEM are shown in Fig. 34 (photograph) and Fig. 35 (illustration of Fig. 34). As shown in Figs. 32 and 34, for both the samples, in addition to a ridge-like streak pattern a specific crack was observed on the surface of the oxide layer. For cracks present on the surface of the oxide layer in each sample, w, l and w/l in crack units having the largest w/l value were determined based on the SEM photograph and were found to be w = 120 nm, l = 2800 nm, and w/l = 0.04 for the sample of Comparative Example 87 and were found to be w = 150 nm, l = 3500 nm, and w/l = 0.04 for the sample of Comparative Example 98. Further, the same observation was carried out for arbitrarily selected 50 visual fields (visual fields having a radius of 30000 nm). As a result, the number of observed specific cracks was 33 in total for Comparative Example 87 and 36 in total for Comparative Example 98.

The results of the observation of the cross-section of the sample of Comparative Example 87 by TEM are shown in Fig. 36 (photograph) and Fig. 37 (illustration of Fig. 36), and the results of the observation of the cross-section of the sample of Comparative Example 98 by TEM are shown in Fig. 38 (photograph) and Fig. 39 (illustration of Fig. 38). As shown in Figs. 36 and 38, elliptical cells (or voids) were observed in all the oxide layers. Further, unlike Example 87, for all the samples, cells were also observed in a part around the interface between the oxide layer and the underlying material.

The corrosion resistance of the wafer mounting surface in the surface oxidized aluminum nitride susceptor thus obtained was evaluated in the same manner as in Example 87.

At the outset, in the corrosion resistance test I, the etching rate was determined from a weight difference between before and after the plasma treatment and was found to be 0.6 $\mu\text{m}/\text{hr}$ for comparative Example 87 and 1 $\mu\text{m}/\text{hr}$ for Comparative Example 98. Further, after the corrosion resistance test, the state of the sample surface exposed to plasma was observed by SEM. As a result, for both Comparative Examples 87 and 98, there was partial dropout of the oxide layer.

Application No. Not Yet Assigned
Paper Dated July 24, 2006
In Reply to USPTO Correspondence of N/A
Attorney Docket No. 1217-062198

Customer No. 28289

Further, in the corrosion resistance test II, the difference in level after plasma treatment between the face which had been masked for the plasma treatment and the etched face was 0.36 μm for Comparative Example 87 and 0.40 μm for Comparative Example 98. --

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